kester's name *polyplast*, which is to be preferred to Haeckel's *morula*.

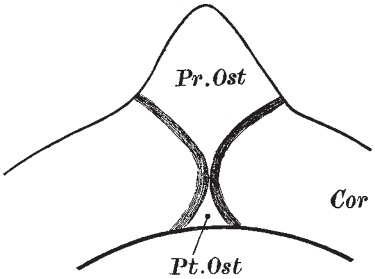
In mosses, the agamobium never gets beyond this stage, the fully formed sporogonium being nothing more than a highly differentiated polyplast. But as in animals the polyplast is succeeded by a gastrula, *i.e.* a stage in which the characteristic organ of animal nutrition has appeared, so in vascular plants it is succeeded by a stage in which the characteristic organs of plant nutrition—the leaf and root—have made their appearance. From ferns up to Angiosperms the first important differentiation after the polyplast is the formation of a cotyledon and of the primary root. This stage, the obvious correlative of the animal gastrula, I propose to call the *phyllula*.

XI.—ON THE PRESENCE OF A STERNUM IN *Notidanus indicus*.

As far as I am aware, nothing answering to a sternum has hitherto been found in fishes, the Urodela being the lowest group in which this constituent of the skeleton is known. In them it consists of a median plate of cartilage formed from paired chondrites (independent cartilaginous elements) developed in the inscriptiones tendineæ immediately caudad of the coracoids, and in close connection with them. In many Anuræ there is found in addition a median element cephalad of the procoracoids. The entire Amphibian sternum is conveniently called by Albrecht the *omosternum*, to distinguish it from the costal sternum of Amniota; the anterior division (omosternum, W. K. Parker) being called the *pre-omosternum*, the posterior division (xiphisternum, auct.) the *post-omosternum*. According to Wiedersheim ("Grundriss," 2te Aufl., p. 58), the phylogeny of the Amphibian sternum is still entirely unknown.

In Elasmobranchs the shoulder-girdle has the form of an inverted arch, usually formed of a single continuous cartilage, due to the union in the middle ventral line of paired elements, one connected with each pectoral fin. In Hexanchus (Notidanus) the right and left sides are described by Hubrecht ("Bronn's Thierreich," Fische, p. 77) as being united by fibrous tissues.

In a skeleton of *Notidanus indicus*, recently prepared for this Museum, the middle region of the shoulder-girdle has the structure shown in the figure. It is produced in front into a blunt process, while it is evenly curved posteriorly. Two curved areas of fibrous tissue, with their convexities towards the median plane, extend from the anterior to the posterior border, touching one another in the centre, and thus bounding two distinct cartilaginous areas—an anterior (*Pr. Ost.*) of a rhomboid, and a posterior (*Pt. Ost.*) of a triangular form. The anatomical relations of these seem to show that the former is to be considered as a pre-omosternum, the latter as a post-omosternum.



Median ventral region of the shoulder-girdle of *Notidanus indicus*, ventral aspect (natural size). *Cor.*, coracoid region: *Pr.Ost.*, pre-omosternum; *Pt.Ost.*, post-omosternum.

The specimen in question appears to furnish a very good indication of the phylogeny of the sternum, and to show that it arose in the first instance by the segmentation of a mid-ventral element from the shoulder-girdle, in much the same way as the basi-hyal and basi-branchials are formed from the hyoid and branchial arches. T. JEFFERY PARKER.

Dunedin, N.Z., September.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. M. J. M. Hill, of University College, London, has been approved for the degree of Doctor in Science.

Mr. H. W. Page, M.C., M.B., of Christ's College, has been appointed an additional Examiner in Surgery.

A. H. L. Newstead, B.A., of Christ's College, has been appointed by the Biology Board to occupy the University table in the Laboratory of the Zoological Station at Naples for six months from December 15, 1890.

Mr. J. Y. Buchanan, F.R.S., University Lecturer in Geography, announces a course of lectures in Physical Geography and Climatology for the ensuing Lent and Easter Terms.

The Clothworkers' Exhibition of fifty guineas a year in natural science for non-collegiate students will be awarded next July. Candidates are to apply to the Censor of Non-Collegiate Students.

The General Board of Studies recommend that Mr. R. T. Glazebrook, F.R.S., be appointed Assistant Director of the Cavendish Laboratory. Mr. Glazebrook resigns the Senior Demonstratorship which he has hitherto held.

A very interesting account is published in the *University Reporter* of December 9, 1890, of the course of study in natural science pursued by the University Extension students who were resident in Cambridge during the last Long Vacation. The course included invertebrate palæontology, practical chemistry, and physics. Courses were also given in Greek art, architecture, Egyptology, &c. The Lectures Committee recommend that the experiment be repeated on a larger scale next year.

Additional demonstrators in physiology and in experimental physics are about to be appointed, to be paid out of the laboratory fees of students.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for November 1890 contains:—On the structure of a new genus of Oligochæta (Deodrilus), and on the presence of anal nephridia in Acanthodrilus, by Frank E. Beddard (plates xxxii. and xxxiii.). This large worm, *Deodrilus jacksoni*, measuring thirteen inches in length by nearly half an inch in diameter at the broadest part, was collected by Prof. Moseley in Ceylon; the nephridia in a species believed to be *Acanthodrilus multiporus* are described as connected with the terminal region of the intestine.—Excretory tubules in *Amphioxus lanceolatus*, by F. Ernest Weiss (plates xxxiv. and xxxv.). At the Zoological Station in Naples, the author was able to have a constant and unlimited supply of Amphioxus, and he took the opportunity of experimenting with the view of determining whether the curious patches of modified epithelial cells on the ventral wall of the atrium of Amphioxus had any excretory function, as Johannes Muller had held to be probable; and whether, also, the atrio-cœlomic funnels, first described by Prof. Ray Lankester, had any such function; positive results were not obtained.—Studies in mammalian embryology; ii. The development of the germinal layers of *Sorex vulgaris*, by Prof. A. W. Hubrecht (plates xxxvi. to xlii.). Giving a brief but very lucid sketch of the various views held by recent writers concerning the gastrulation process of the Amniota and the formation of their mesoblast and notochord, placing what is agreed on on the one side, and indicating the points of difference on the other, without any polemical remarks, the author proceeds to an account of the early developmental stages of Sorex, the blastula and the didermic blastocyst, the development of the mesoblast; then follow some theoretical considerations on the gastrulation of the Mammalia, concluding with points of comparison in earlier investigations by other authors.—Terminations of nerves in the nuclei of the epithelial cells of tortoiseshell, by Dr. J. B. Haycraft (plate xliii.). The scutes of the land tortoise (*Testudo græca*), in spite of their hard, dense nature, form a very typical epidermic sensory covering for the animal. As in the soft skin of mammals, the nerves end in localized sensitive spots in the epidermis, and before penetrating this tissue they form a horizontal plexus in the upper part of the connective tissue; figures of the nerve-endings are given.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 27.—"The Variations of Electromotive Force of Cells consisting of certain Metals, Platinum, and Nitric Acid." By G. J. Burch and V. H. Veley.

The description of the apparatus, the capillary electrometer, and the method of working are given fully in the paper. The following conclusions are drawn from the results of the experiments:—

(1) When the metals copper, silver, bismuth, and mercury are introduced into purified nitric acid of different degrees of concentration, and a couple made of platinum, the electromotive force of such a cell increases considerably from an initial value until it reaches a constant and (in most cases) a maximum value. The rise of E.M.F. is attributed to the production of nitrous acid by the decomposition of the nitric acid, and the final value is considered to be due to the former acid only, while the initial value is due for the most part to the latter acid, though it is affected to a remarkable degree by the amount of impurity of nitrous acid, either initially present or produced by minute and unavoidable uncleanliness of the metallic strip and the containing vessel.

(2) If nitrous acid has been previously added to the nitric acid, then the maximum E.M.F. is reached *at once.*

(3) If the conditions—namely, increase of temperature, of impurity, and of concentration of acid—are such as would favour a more rapid solution of the metal, and consequently a more rapid production of nitrous acid, then the rise of E.M.F. is concomitantly more rapid.

(4) Conversely, if the conditions are unfavourable to the production of nitrous acid, the rise of E.M.F. is less rapid.

(5) If any substance, such as urea, be added which would tend to destroy the nitrous acid as fast as it may be formed, then the rise of E.M.F. is extremely slow, being dependent upon the number of molecular impacts of the nitrous acid upon the surface of the metal.

Thus the results obtained by the electrometer and by the chemical balance are in every way confirmatory the one of the other.

The authors propose to conduct further investigations on cells containing other acids, to determine whether the action of them upon metals is conditioned by the presence of their products of electrolysis.

Geological Society, November 26.—Dr. A. Geikie, F.R.S., President, in the chair.—The appointment of Mr. L. Belinfante as Assistant-Secretary was confirmed.—The following communications were read:—Account of an experimental investigation of the law that limits the action of flowing streams, by R. D. Oldham, Deputy Superintendent of the Geological Survey of India. A discussion followed, in which Dr. Blanford, Mr. Binnie, Mr. Topley, and the President took part.—On the rocks of North Devon, by Dr. Henry Hicks, F.R.S. During a recent visit to North Devon the author obtained evidence which has led him to believe that far too little importance has hitherto been assigned to the results of movements in the earth's crust as affecting the succession of the rocks in that area. The supposed continuous upward succession from the rocks on the shore of the Bristol Channel to those in the neighbourhood of Barnstaple, including, according to some authors, no less than ten groups, and classed into three divisions under the names Lower, Middle, and Upper Devonian, is, the author believes, an erroneous interpretation. The beds, he says, have been greatly plicated and faulted, and consequently several times repeated, and instead of being one continuous series, they occur folded in more or less broken troughs. In the Morte Slates, previously considered unfossiliferous, the author found a *Lingula,* and he believes that these slates are the oldest rocks in the area, and formed the floor upon which the Devonian rocks were deposited unconformably. As the result of movements in the earth's crust, the Morte Slates have been brought to the surface and thrust over much newer rocks, producing a deceptive appearance of overlying the latter conformably. The Morte Slates mark the dividing line between the two main troughs. On the north side in ascending order are the Hangman (or Lynton), Combe Martin Bay, and Ilfracombe Beds, and on the south side the Pickwell Down, Baggy Point, and Pilton Beds. Those on the south side of the Morte Slates are, the author believes, a repetition of the beds on the north side. The palæontological evidence is not antagonistic to this view, for an analysis of the Brachiopoda, the only group of fossils in the beds on the south side, which hitherto have been systematically examined, shows that of the twenty species mentioned by Mr. Davidson and others as occurring in the Pickwell Down, Baggy Point, and Pilton Beds (the so-called Upper Devonian rocks), no less than thirteen have already been found in the Middle or Lower Devonian rocks on the north side of the Morte Slates. Four others are recognized Middle Devonian species in other areas; and the three remaining are either doubtful species or ones which have a great vertical range. These facts show that the so-called Upper Devonian rocks in this area do not contain a distinguishing fauna of any importance; and the stratigraphical evidence is opposed to the view that they are a series of rocks distinct from those on the north side of the Morte Slates, which have been classed as Middle and Lower Devonian. In the discussion which followed the reading of this paper the speakers were Mr. T. Roberts, Mr. Marr, Prof. Seeley, Mr. H. B. Woodward, Rev. H. H. Winwood, Rev. G. F. Whidborne, Mr. Hudleston, Prof. Blake, the President, and the author. The President remarked that, in altering the recognized order of succession of these rocks, the author would have to reckon also with continental stratigraphers and palæontologists. Dr. Hicks had not made as clear as might be the evidence for such thrust-planes and faults as his views of the structure of the ground required. The plications and dislocations in South Devon and Cornwall, although abundant and often very complicated, appeared to the speaker to be on a comparatively small scale; and, although he did not wish to insist that this must be the case in North Devon, he felt that it might be so.—A special general meeting was held at 7.45 p.m., before the ordinary general meeting, at which Mr. J. W. Hulke, F.R.S., was elected Foreign Secretary, and Mr. J. J. H. Teall, F.R.S., was elected a Member of Council.

Zoological Society, December 2.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of November 1890, and called special attention to the acquisition of a specimen of the Cryptoprocta (*Cryptoprocta ferox*) of Madagascar.—A letter was read from M. A. Milne-Edwards, containing an account of the mode in which the typical specimen of Grévy's Zebra had been mounted for the Gallery of the Museum, and pointing out that the mounted specimen has been carefully modelled after the living animal.—A letter was read from Dr. Emin Pasha, dated "Tabora, East Africa, August 16, 1890," containing an expression of his thanks for having been elected a Corresponding Member; and giving some remarks on the Striped Hyena of that district.—Mr. Richard Crawshay read a paper on the Antelopes of Nyassaland, treating especially of those to be met with west of the Lake. Lichtenstein's Hartebeest was stated to be very generally distributed, and seven other Antelopes to be plentiful. The Kudu, Sable Antelope, and Black-tailed Gnu were seldom met with; but exact localities were given where these Antelopes were to be found. In conclusion, the author added that there are at least two other species of small Antelopes found in the hills, which hitherto he had not been able to identify.—Prof. G. B. Howes read a paper on the peculiar mode of the suspension of the viscera in the Australian Batoid fish *Hypnos subnigrum.*—A second communication from Prof. Howes contained notes on the pectoral fin-skeleton of the Batoidea and of the extinct genus *Squaloraia,* which he maintained must be referred to the Chimæroid group.—Mr. G. A. Boulenger read a paper on the presence of pterygoid teeth in a tailless Batrachian (*Pelobates cultripes*), and added remarks on the localization of the teeth on the palate in the Batrachians and Reptiles.—Mr. H. Seebohm read a paper on the Fijian birds of the genus *Merula,* and gave a description of a new species from Viti-Levu, which he proposed to call *Merula layardi.*

Edinburgh.

Royal Society, December 1.—Sir Douglas Maclagan, President, in the chair.—This was the first meeting of the Society for the present session.—After the delivery of the President's opening address, Prof. Crum Brown read an obituary notice of Prof. Kolbe.—Dr. John Gibson submitted the results of an analytical examination of manganese nodules, made with special reference to the occurrence of the rarer elements. The nodules which he examined were dredged by the *Challenger* in the North Atlantic. Dr. Gibson has detected the presence of twenty-eight elements. Of these, zinc, tellurium, molydenum, vanadium, and thallium have never previously been observed.—Mr. J. Y. Buchanan, F.R.S., read a paper on the occurrence of sulphur in marine muds and nodules, and its bearing on their modes of formation. The sand and mud at the bottom of the sea, at all depths, forms the food of a numerous and important ground-fauna. In the search after their food, the animals are continually passing large quantities of the mud through their bodies. Evidence of this is supplied by the coprolitic structure of all finer muds, which is rendered visible by careful levigation. The effect of trituration of silicates, under distilled water alone, has been shown to result in partial decomposition. When the milling apparatus is situated in the inside of an animal, and is therefore moistened by organic secretion as well as by sea-water, it is well-known that reaction, resulting in the reduction of the sulphates in the water, takes place. If the silicates, which are being triturated and partially decomposed, contain iron and manganese, the sulphides of iron and manganese are produced, and, being rejected by the animal, form a more or less bluish mud. When this mud lies on the surface of the sea bottom, and is exposed to the action of the sea-water, which always contains dissolved oxygen, the sulphides are oxidized, so that the reddish-brown surface layer, so frequently observed, is formed. When the sulphides come into contact with pre-existing higher oxides, such as Fe_2O_3, ferrous oxide is formed, and sulphur is separated. Reasoning on these grounds, Mr. Buchanan concluded that it must be possible to find free sulphur in all marine muds. In blue muds the sulphur is partly pre-existent, and is partly formed on drying in the air. In red clays, and in manganese nodules, it is wholly pre-existent. Examination of twenty-five muds, and of nodules from all regions, comfirmed this view, as they all gave up sulphur on exhaustion with chloroform. Mr. Buchanan made a number of experiments on the reaction of the sulphides of iron and of manganese on the ferric salts and oxide. He found that precipitated MnS acts on solutions of iron salts exactly in the same way as an alkaline sulphide does. It reduces ferric salts, and at once, and completely, precipitates ferrous salts as FeS. The reactions of MnS on ferric hydrates gave interesting indications regarding the probable nature of the "red cherty particles" so frequently observed in manganiferous bottoms. Mr. Buchanan concludes that the ochreous matter, hydrated oxides of iron and manganese, so abundant on the surface of the bed of the ocean, spring from silicates, and other combinations, by reduction to sulphides in a process of digestion and subsequent oxidation by the atmospheric oxygen of the sea-water. They may also be re-reduced and re-oxidized repeatedly.—Dr. John Murray communicated an anatomical description, by Mr. F. E. Beddard, of two new genera of aquatic Oligochætæ.—Mr. John Aitken exhibited and described a pocket form of his dust-counter, intended for meteorological observations. This form of the instrument is much reduced in size, and is greatly simplified in construction.

PARIS.

Academy of Sciences, December 1.—M. Duchartre in the chair.—On the Fourchambault tornado, by M. H. Faye. The author points out, among other things, that it will be extremely interesting to verify M. Dommet-Adamson's assertion that the gyrations took place in the same direction as the hands of a watch. This has also been noticed in some tornados in the United States, but is very rare.—On some new fossil plants observed at Portugal, and indicating the passage from the Jurassic to the Lower Cretaceous formation, by M. G. de Saporta.—Observations of Zona's new comet, made at Algiers Observatory, with the *coudé* equatorial of 0·318 metres aperture, by MM. Trépied, Rambaud, and Renaux. Observations for position were made on November 17, 18, and 20.—On a new method of displacement of a double cone, by M. A. Mannheim.—On the compressibility of mixtures of air and carbon dioxide, by M. Ulysse Lala. The author has experimented upon mixtures containing 11, 19·35, 26·29, 33·33, 40·08, 47·54, and 56·92 per cent. of carbon dioxide. Between the limits of his experimental pressures, viz. 100·38 cm. of mercury, with volume = 1, and 1613·96 with volume = 0·5, the compressibility of mixtures of dry air and carbon dioxide, when the quantity of the latter gas does not exceed about 22 per cent., is contained between those of the two gases used. It was observed that with mixtures richer in carbon dioxide the compressibility increased.—Reflection and refraction by bodies with abnormal dispersion, by M. R. Salvador Bloch.—On a new process for the differentiation of arsenic and antimony metallic mirrors produced on porcelain, by M. G. Denigès.—On an epithelial fibrillous tissue of Annelides, by M. Et. Jourdan.—Influence of acetic acid on gaseous respiratory changes, by M. Alfred Mallèvre.—On a new haemato-alkalimetric method, and on the comparative alkalinity of the blood of the vertebrata, by M. René Drouin. It is shown that if the alkalinity of the serum of the blood of different species of vertebrata be tabulated, the values may be divided into groups following precisely the same order as the zoological affinities, and that the order in which these classes succeed one another is the same as that of the increase of activity of respiration.—On the structure of nervous centres of *Limulus polyphemus*.—On the external differences presented by the *Nematobothrium, a propos* a new species (*N. Guernei*), by M. R. Moniez.—The enterocele nervous system of Echinodermata, by M. L. Cuénot.—Experimental researches on the locomotion of Arthropods, by M. Jean Demoor.—Comparative influence of light and weight on mosses, by M. Eugène Bastit.—On the presence of lactifers in Fumariaces, by M. L. J. Léger.—Principal indices of refraction of anorthite, by MM. A. Michel Lévy and A. Lacroix.—On the tempest of November 23 and 24, 1890, and the vertical movements of the atmosphere, by M. Alfred Angot.

STOCKHOLM.

Royal Academy of Sciences, November 12.—On the spectrum of absorption of brome, by Prof. Hasselberg.—Determinations of the longitude between the Observatories of Stockholm, Copenhagen, and Christiania, executed by C. F. Fearnley, F. C. Schjellerup, and D. G. Lindhagen.—On the recently executed expedition to Spitzbergen, conducted by G. Nordenskiöld, and its scientific results, by Baron Nordenskiöld.—On the results of the latest Swedish hydrographic expedition in Skagerack and Kattegat during the winter 1890, by Prof. O. Pettersson.—On floating pumices and slags stranded on the shores of North Europe, by Hr. H. Bäckström.—Mineralogical notes, iii., by Hr. G. Flink.—On the employment of infinite determinants in the theory of linear, homogeneous, differential equations, ii., by Hr. H. von Koch.—On a single case of permanent movement with rotation, by Hr. E. Phragmén.—On the waterspout at Wimmerby, July 4, 1890, by Hr. T. Wigert.—On the oxidation of phenyl-methyl-triazol-carbon acid, ii. Phenyl-triazol-dicarbon acid; *a*. The constitution of phenyl-triazol-carbon acid, by Dr. Bladin.—On the constitution of the cummenyl-propion acid, by Prof. Widman.—On the shifting from propyl to isopropyl in the cumin series of the latter, by Prof. Widman.—A review of the mosses of Småland, by Hr. R. Tolf.—Researches on the soft parts of the supernumerary radii of the hand and the foot, by Miss A. Carlsson.

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